

ART. VI.—*A description of the Silver Mines of the Cerro de Pasco, and the Journey to them across the Andes.* By JOHN CAIRNS, Esq.

[Read before the Institute, 1st June, 1859.]

THE Silver Mines of the Cerro de Pasco are situated about 50 leagues from Lima, beyond the Andes, which the traveller has to cross at an elevation of about 1600 to 1700 feet above the level of the sea. This peak, or ridge, being surmounted, you gradually descend to the Pampas, and at a distance of twenty leagues you reach the Cerro, or mountain of Pasco, at the summit of which, in a hollow basin surrounded on all sides by lofty hills, are the silver mines, in lat. $10^{\circ} 48' S.$, long. $76^{\circ} 23' W.$

The works of the English Mining Company, under the superintendence of Mr. Jump, one of the partners, form a prominent feature in the picture below you, and the white-washed buildings remind one strongly of the large printing or bleaching establishments seen at home. These works are instituted for the crushing and amalgamation of the ore which is brought from the mines, almost close at hand.

I had fully expected that the ore obtained in silver mines would display, in some degree, the pure metal; but in this I was disappointed, on being shown large heaps of yellowish brown earth, very like gravel, in the substance of which is the hidden treasure. Occasionally in *very* rich ore native silver is visible, but veins of such are not often met with.

Like the Burra Burra and its copper treasures, the Cerro is almost one mass of ores of varied values, in great variety of combination, amongst which are to be found silver, copper, lead, arsenic, mercury, and sometimes gold. Notwithstanding the appliances of English machinery in these works, Mr. Jump seems to consider his operations very imperfect, and expressed his belief that in the refuse, which he reserved in a large pit or reservoir, there was still left as much silver as had already been extracted, the imperfect process only removing about 50 per cent. of the actual contents.

Messrs. Jump and Conroy's works being only a short distance from the principal mines, I was conducted to the latter by one of his staff, and introduced to an overseer, who accompanied me into the mines, after first arming me with a thick cap for my head, and furnishing me with a long iron clasp holding a candle.

Although the very surface of the mountain is argentiferous, some of the richer deposits are at depths varying from 100 to 200 yards. The working of the latter is much impeded by the presence of water, to pump out which great expense has been incurred by the Society of Miners and owners of mines; but on account of jealousy, and the consequent want of unity of action, the valuable machinery brought out from England, and already erected, is going to decay, without affording the slightest advantage to any one.

Many of the mines are entered from the houses of their owners, whilst the mouths or entrances to others are protected by small stone porches and well-fastened doors.

My guide led the way to one of the deepest shafts, which we descended from the surface by precipitous steps cut out of the mountain in a very rough style, the width and height being occasionally little more than enough to allow the miner to pass with the bag of ore on his back.

At other points where valuable masses of ore had been found, the excavation was considerable, and required the greatest caution to avoid a precipitous fall. At various depths the shafts run almost horizontally, as the deposits of ore may have occurred; after traversing which, you reach other descending shafts, and by this means attain the different levels. Though the temperature was occasionally oppressive, it did not at all approach to what I had experienced either in the Burra Burra copper mines, or the Monkwearmouth coal mines at Sunderland, the men being able to work without diminution of clothing.

Tired as I was with the mere exertion of descent, I felt thankful it was not my lot to carry up by those steep paths the heavy knapsacks of ore under which the poor natives were toiling, there being as yet no machinery at work to save labour. These knapsacks are made of untanned hide, and contain about 70 lbs. to 75 lbs. of ore, and are fitted with arm straps. The native stretches himself on the ground, inserts his arms through the straps, and then rising up, trots away with a nimbleness almost incredible.

The bags of ore, on being brought to the surface, are poured out into heaps and then measured; after which, by the aid of mules, asses, horses, or llamas, the ore is carried to the works for grinding, &c.

As in other mines previously visited, the passages from one shaft to another were occasionally so limited as to require the serpent's mode of locomotion, and on reaching the lowest

water level it was no easy task to save oneself from a plunge into the stream, which at places was rather deep. In two instances fatigue and the narrow passages caused me to slip, and I was glad to escape after being but half immersed. I longed for the powerful engines of Monkwearmouth to aid my ascent, and was inexpressibly delighted when at length I did discover signs of daylight; for though the depth was not more than 300 to 400 feet, the distance traversed, whilst following the tortuous windings of the several leads of ore, was very great.

That part of the mountain already worked having in a great measure fallen in, another basin is thereby formed, the whole of which seemed alive with quadrupeds of all kinds; whilst the appearance and disappearance of the miners, as they emerged from or entered the innumerable little holes in the mountain side, reminded one of a rabbit warren or an ant-hill. The natives have no beauty of feature to boast of, nor are they improved by the habit of chewing "coca," which they stuff into their mouths to such an extent as to cause a protuberance of the cheeks, which at first I took for a disease, until informed to the contrary.

The miners almost universally chew the coca, and take a supply of the article into the mines with them, which, in one instance, was the means of preserving the lives of several men for many days. The roof of the mine having fallen in, the buried men had no means of egress until rescued by their companions, after several days' confinement, life being alone sustained by "coca," of which it fortunately happened they had a plentiful supply.

In one deserted mine there are still buried several miners, neither the richness of the ore, which was remarkable, nor the love of friends, being strong enough to induce further search for those unfortunates, who some years ago were buried alive. I forget the Spanish name since given to the mine, but the literal meaning is "the mine of death."*

Our point of egress from the bowels of mother earth was at some distance from the shaft by which we entered, but the cooling mountain breeze was not the less welcome. The noise of the pick and hammer below was exchanged for the gibberish of innumerable ant-like beings who, emerging from their burrow, deposited their burthens on the surface, and leisurely

* ["La mina de la muerte."—Ed.]

disappeared with their swollen cheeks to bring up fresh loads of the precious ore.

We will now follow the ore to the grinding and amalgamating works, where it has to undergo sundry operations before the silver bar is cast and ready for export.

In many establishments the crushing of the ore is done in a very primitive style by the aid of large circular stones, worked by mules or horses, but at Messrs. Jump and Conroy's hacienda, a small steam engine works a number of massive Chilian mills with a power and regularity far exceeding that of the more primitive means. Each mill consists of a pair of stones 6 to 10 feet high, working perpendicularly in a circular trough, on the same principle as we have most of us seen adopted in madder mills at home.

Water being supplied to aid the crushing process, a kind of mortar is produced, which is thence transferred to the "circos," or circular walled pits, in which it is trampled by the feet of 8 or 10 horses driven round by an energetic driver. Stationed on a central block of stone, he cracks his whip furiously, and, on finding its report to fail, jumps into the puddle, and applies still more persuasive arguments. The increased trampling aids the more effectual combination of the ore and salt, with which latter the "circo" has been previously charged.

After many days similar trampling a certain amount of mercury is added, and the same trampling and mixing process continued for some weeks. After this a stream of water is forced through the circo, thereby clearing the less heavy muddy particles from the amalgam of silver and mercury. The latter, by its own specific gravity, is precipitated into pits, along a channel, in which men are placed to agitate the stream and retard the progress of the precious contents. These they trample into leathern bags previously placed at the bottom of each hole or well.

Great care is taken to wash and examine the feet of both men and horses during these trampling processes, as otherwise much amalgam might be carried away.

The circo being thus thoroughly washed out, the bags containing the amalgam are carried to the inner storerooms of the establishment, where by pounding the amalgam the mercury is in a great measure pressed through the pores of the leather and deposited in a receptacle below.

The mass still remaining in the leathern bag, not yet pure, is now poured into rough moulds like cheese presses.

The moulds are transferred to a furnace, where, by sublimation, much of the remaining mercury is evaporated and subsequently recovered, leaving the pure metal in somewhat similar moulds to that of a small Cheshire cheese. These are then sent to the Government Smelting Works, which are conducted in a very free and easy style. When the furnace has reduced the metal to a proper state, the crucible's molten contents are poured into a rough mould, in which hay or straw has been previously placed. At the moment of contact the latter ignites, thereby producing a gas which I was given to understand prevented splashing or bubbling of the metal, which would otherwise ensue. After remaining a short time in the mould, the bar is tossed over on the floor, and any rough edges are well hammered whilst soft. Next follows the cooling, as if it were a piece of iron in a blacksmith's shop. Weighing and stamping with the progressive number, marks, &c., of the revenue, weight and value, complete the whole, and the bar is then ready for transmission to Lima, on the backs of mules.

These ingots are sent down the mountains without the slightest protection, as the banditti know that they are of no use to them in the state they are, and prefer occasionally attacking the escort coming up to the mines with coin for the payment of wages and purchase of metal.

ART. VII.—*On some Domesticated Animals of South America which would be useful in Victoria.* By P. NISSER, Esq.

[Read before the Institute, 22nd June, 1859.]

FOR some peculiar reason the regions of Chili, Lower and Upper Peru, but especially the latter, are the more favored regions of the vast South American continent, where varieties of animal tribes exist which have proved of great importance to the original occupiers of that part of our globe. Previous to the conquest and extinction of the great empire of Peru, much care and attention was paid to the animals termed by the Spaniards Peruvian sheep, but now known as the Llama, Alpaca, and Vicuna. The Llama is the tallest and most corpulent of the three, and is well known as having been the only domesticated animal of burden in South America previous to the conquest by the Spaniards. It was